

Claims

1. A method of producing magnetic or metal oxide nanoparticles, comprising:

(1) adding a magnetic or metal precursor to a surfactant or a solvent containing the

5 surfactant to produce a mixed solution;

(2) heating the mixed solution to 50 – 600 °C to decompose the magnetic or metal precursor

by heating so as to form the magnetic or metal oxide nanoparticles; and

(3) separating the magnetic or metal oxide nanoparticles.

10 2. The method as set forth in claim 1, wherein the magnetic precursor is selected from the group consisting of a metal nitrate-based compound, a metal sulfate-based compound, a metal fluoroacetooacetate-based compound, a metal halide-based compound ( $MX_a$ , where  $M = Ti, Zr, Ta, Nb, Mn, Sr, Ba, W, Mo, Sn, or Pb, X = F, Cl, Br, or I, and 0 < a \leq 5$ ), a metal perchlorate-based compound, a metal sulfamate-based compound, a metal stearate-based compound, and an organometallic compound.

15 3. The method as set forth in claim 2, wherein the metal nitrate-based compound is selected from the group consisting of iron(II) nitrate, iron(III) nitrate, manganese nitrate, cobalt nitrate, zinc nitrate, nickel nitrate, and copper nitrate.

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4. The method as set forth in claim 2, wherein the metal sulfate-based compound is selected from the group consisting of iron sulfate (II), iron sulfate (III), manganese sulfate, cobalt sulfate, nickel sulfate, copper sulfate, and zinc sulfate.

5. The method as set forth in claim 2, wherein the metal fluoroacetoacetate-based compound is selected from the group consisting of iron trifluoroacetoacetate, cobalt hexafluoroacetoacetate, manganese hexafluoroacetoacetate, nickel hexafluoroacetoacetate, copper hexafluoroacetoacetate, and zinc hexafluoroacetoacetate.

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6. The method as set forth in claim 2, wherein the metal halide-based compound is selected from the group consisting of iron(II) chloride, iron(III) chloride, cobalt chloride, nickel chloride, copper chloride, zinc chloride, gadolinium chloride, iron(II) bromide, iron(III) bromide, cobalt bromide, nickel bromide, copper bromide, zinc bromide, iron(II) iodide, iron(III) iodide, manganese iodide, nickel iodide, copper iodide, zinc iodide, and cobalt iodide.

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7. The method as set forth in claim 2, wherein the metal perchlorate-based compound is selected from the group consisting of iron(III) perchlorate, cobalt perchlorate, manganese perchlorate, nickel perchlorate, copper perchlorate, and zinc perchlorate.

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8. The method as set forth in claim 2, wherein the metal sulfamate-based compound is selected from the group consisting of iron sulfamate, manganese sulfamate, nickel sulfamate, cobalt sulfamate, copper sulfamate, and zinc sulfamate.

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9. The method as set forth in claim 2, wherein the metal stearate-based compound is selected from the group consisting of iron stearate, manganese stearate, nickel stearate, copper stearate, cobalt stearate, and zinc stearate.

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10. The method as set forth in claim 2, wherein the organometallic compound is selected from the group consisting of iron(III) meso tetraphenylporphin oxo dimer, tris(2,2,6,6-tetramethyl-

3,5-heptanedionate)iron(III), bis(2,2,6,6-tetramethyl-3,5-heptanedionate)nickel, bis(2,2,6,6-tetramethyl-3,5-heptanedionate)cobalt, bis(2,2,6,6-tetramethyl-3,5-heptanedionate)copper, bis(2,2,6,6-tetramethyl-3,5-heptanedionate)zinc, and bis(2,2,6,6-tetramethyl-3,5-heptanedionate)manganese.

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11. The method as set forth in claim 1, wherein the metal precursor is a metal halide-based compound ( $MX_a$ , where  $M = Ti, Zr, Ta, Nb, Mn, Sr, Ba, W, Mo, Sn, or Pb, X = F, Cl, Br, or I, and 0 < a \leq 5$ ).

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12. The method as set forth in claim 11, wherein the metal halide-based compound is selected from the group consisting of titanium tetrachloride, zirconium tetrachloride, tantalum pentachloride, tin tetrachloride, tungsten chloride, molybdenum tetrachloride, manganese chloride, titanium tetrabromide, zirconium tetrabromide, tantalum pentabromide, tin tetrabromide, and manganese bromide.

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13. The method as set forth in claim 1, wherein the surfactant is selected from the group consisting of organic acid ( $C_nCOOH$ ,  $C_n$ : hydrocarbon,  $7 \leq n \leq 30$ ) and organic amine ( $C_nNH_2$ ,  $C_n$ : hydrocarbon,  $7 \leq n \leq 30$ ), alkane thiol ( $C_nSH$ ,  $C_n$ : hydrocarbon,  $7 \leq n \leq 30$ ), phosphonic acid ( $C_nPO(OH)_2$ ,  $C_n$ : hydrocarbon,  $7 \leq n \leq 30$ ), alkyl phosphate, trioctylphosphine oxide, tributyl phosphine, alkyl sulfate, and tetraalkylammonium halide.

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14. The method as set forth in claim 13, wherein the organic acid is selected from the group consisting of oleic acid, lauric acid, stearic acid, mysteric acid, and hexadecanoic acid.

15. The method as set forth in claim 13, wherein the organic amine is selected from the group consisting of oleyl amine, lauryl amine, trioctyl amine, dioctyl amine, and hexadecyl amine.

16. The method as set forth in claim 13, wherein the alkane thiol is selected from the group 5 consisting of dodecane thiol, hexadecane thiol, and heptadecane thiol.

17. The method as set forth in claim 13, wherein the phosphonic acid is selected from the group consisting of tetradecyl phosphonic acid and octadecyl phosphonic acid.

10 18. The method as set forth in claim 1, wherein the solvent is selected from the group consisting of an ether-based compound ( $C_{n_2}O$ ,  $C_n$ : hydrocarbon,  $5 \leq n \leq 30$ ), hydrocarbon ( $C_nH_m$ ,  $7 \leq n \leq 30$ ), organic acid ( $C_nCOOH$ ,  $C_n$ : hydrocarbon,  $7 \leq n \leq 30$ ) and organic amine ( $C_nNH_2$ ,  $C_n$ : hydrocarbon,  $7 \leq n \leq 30$ ), and alkane thiol ( $C_nSH$ ,  $C_n$ : hydrocarbon,  $7 \leq n \leq 30$ ).

15 19. The method as set forth in claim 18, wherein the ether-based compound is selected from the group consisting of octyl ether, benzyl ether, and phenyl ether.

20. The method as set forth in claim 18, wherein the hydrocarbon is selected from the group consisting of hexadecane, heptadecane, and octadecane.

20 21. The method as set forth in claim 18, wherein the organic acid is selected from the group consisting of oleic acid, lauric acid, stearic acid, mysteric acid, and hexadecanoic acid.

22. The method as set forth in claim 18, wherein the organic amine is selected from the 25 group consisting of oleyl amine, trioctyl amine, dioctyl amine, and hexadecyl amine.

23. The method as set forth in claim 18, wherein the alkane thiol is selected from the group consisting of dodecane thiol, hexadecane thiol, and heptadecane thiol.

5 24. The method as set forth in claim 1, wherein the surfactant is contained in the mixed solution in an amount that is 1 – 100 times the amount of the magnetic or metal precursor.

25. The method as set forth in claim 1, wherein the solvent is contained in the mixed solution in an amount that is 1 – 100 times the amount of the magnetic or metal precursor.

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26. The method as set forth in claim 1, wherein the mixed solution containing the magnetic precursor is heated at 50 – 600 °C for 30 min – 3 hours.

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27. The method as set forth in claim 1, wherein the mixed solution containing the metal precursor is heated at 50 – 600 °C for 1 min – 2 hours.

28. The method as set forth in claim 1, wherein sizes of the magnetic oxide nanoparticles are controlled by adjusting a concentration of the magnetic precursor.

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29. The method as set forth in claim 1, wherein diameters of the metal oxide nanoparticles are controlled by adjusting a concentration of the surfactant when one type of surfactant is used, or by adjusting a composition ratio of surfactants when two types of surfactant are used.

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30. The method as set forth in claim 1, wherein the magnetic oxide nanoparticles include single component magnetic oxide nanoparticles or composite magnetic oxide nanoparticles.

31. The method as set forth in claim 30, wherein the single component magnetic oxide nanoparticles include  $M_xO_y$  ( $M = Fe, Ni, Co, Gd, Mn, Zn, Cr, or Cu, 0 < x \leq 3, 0 < y \leq 4$ ).

5 32. The method as set forth in claim 30, wherein the composite magnetic oxide nanoparticles include  $MM'_2O_4$  ( $M$  and  $M' = Co, Ni, Mn, Zn, Gd, or Cr$ ).

33. The method as set forth in claim 1, wherein the metal oxide nanoparticles include single component metal oxide nanoparticles or composite metal oxide nanoparticles.

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34. The method as set forth in claim 33, wherein the single component metal oxide nanoparticles include  $M_xO_y$  ( $M = Ti, Zr, Ta, Nb, Mn, Sr, Ba, W, Mo, Sn, or Pb, 0 < x \leq 3, 0 < y \leq 5$ ).

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35. The method as set forth in claim 33, wherein the composite metal oxide nanoparticles include  $BaTiO_3, PbTiO_3, ZrTiO_3, BaSr_xTi_{1-x},$  or  $PbZr_xTi_{1-x}O_3$  ( $0 \leq x \leq 1$ ).